WHAT IS CLAIMED IS:

1. A fine carbon fiber having an outer diameter of about 1 to about 80 nm, an aspect ratio of 10 to 30,000, R value (I_D/I_G) by Raman spectrophotometry of about 0.6 to about 1.6, and an interplane distance C_0 by X-ray diffraction of 6.70 to 6.95 Angstroms, and having a cross-section perpendicular to the longitudinal direction of the carbon fiber being of a polygonal shape, comprising a hollow center portion and substantially a multi-layer sheath structure of a plurality of carbon layers.

2. A fine carbon fiber having an outer diameter of about 1 to about 80 nm, an aspect ratio of 10 to 30,000, R value (I_D/I_G) by Raman spectrophotometry of about 0.1 to about 1, and an interplane distance C_0 by X-ray diffraction of 6.70 to 6.90 Angstroms, and having a cross-section perpendicular to the longitudinal direction of the carbon fiber being of a polygonal shape, comprising a hollow center portion and substantially a multi-layer sheath structure of a plurality of carbon layers.

3. The fine carbon fiber as claimed in claim 1 having a cross-section perpendicular to the longitudinal direction of the carbon fiber being of a polygonal shape, comprising a hollow center portion and a multi-layer sheath structure of

a plurality of carbon layers in the form of annular rings around the hollow part.

4. The fine carbon as claimed in claim 2, having a cross-section perpendicular to the longitudinal direction of the carbon fiber being of a polygonal shape, comprising a hollow center portion and a multi-layer sheath structure of a plurality of carbon layers in the form of annular rings around the hollow part.

5. Fine carbon fiber having an outer diameter of about 1 to about 80 nm and an aspect ratio of 10 to 30,000, comprising the fine carbon fiber as claimed in any one of claims 1 to 4 in an amount of about 10 mass% or more.

6. A fine carbon fiber produced by a method which comprises a step of causing an organic compound solution containing an organic transition metal compound and, optionally a sulfur compound to vaporize, and feeding the vaporized solution to a reaction furnace while the temperature of the solution is maintained below the decomposition temperatures of the organic transition metal compound; a step of feeding a carrier gas which has been heated to a high temperature to the reaction furnace through a path separate from that of the solution; and a step of causing the vaporized solution and the carrier gas to be

combined in a heated reaction zone of about 700 to about 1,300°C in the reaction furnace, to thereby carry out reaction instantaneously.

7. A fine carbon fiber as claimed in claim 6, wherein the temperature to which the carrier gas has been heated is about 500 to about 1,300°C.

8. A fine carbon fiber obtained by further subjecting to heat treatment the fine carbon fiber claimed in claim 6.

9. A fine carbon fiber as claimed in claim 8, wherein the heat treatment temperature is about 900 to about 3,000°C.

10. The fine carbon fiber as claimed in claim 8 or 9, wherein the temperature to which the carrier gas has been heated is about 500 to about 1,300°C.